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Are They Ready? Integrating Workforce Readiness into a Four-Year College IT/IS Curriculum

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ABSTRACT

The fast pace of change in industry trends, practices, and technologies mandates that college students graduate with portable competencies and skills to enter the workplace. However, employers' concerns of skill shortages among college graduates keep surfacing in various workforce readiness reports and surveys. The purpose of this paper is to present a workforce development framework that can be used to guide higher education educators in Information Technology and related 4-year programs to bridge the aforementioned gap. We integrated the CERT® workforce development model with the experiential learning model as the essential guiding principles in developing the undergraduate IT program. Further, we demonstrate our detailed curriculum programming and discuss how the guiding principles have been implemented to improve IT students' workforce readiness, starting from freshman year and through their college lives. The paper concludes with the evaluation process and discussions on outcome assessment results.

Keywords

Workforce readiness, undergraduate, IT curriculum, 21st century skills, evaluation

INTRODUCTION

Today's employers seek college graduates equipped with more than just technology skills. They require practical experience and reasoning ability as well as essential competencies like adaptability, problem-solving, and leadership (Piliouras et al., 2014).

A recent study found that 40% of college students graduate without the critical thinking and written communication skills needed for today's workplace (The Council for Aid to Education, 2016). Another report, based on the 2016 McGraw-Hill Education Workforce Readiness Survey, discovered that only 21% of undergraduates felt "very" prepared to join the workforce and 67% felt that their workforce readiness could be improved through more internships, more time for career preparation, and better access to preparation tools (Hanover Research, 2016). Further, the Innovative Imperative Series provided insights in on-demand skills and competencies sought by "hiring decision makers" with 73% of business leaders expressing concern of a substantial skills gap in the current U.S. workforce (Northeastern University, 2014).

These issues are particularly significant in the Information Technology (IT) field where significant change has been driven by disruptive innovations, including the Internet, mobile technology, and cloud computing. These have revolutionized the way people communicate and work, created new business practices, and generated needs for new infrastructures and different labor skills (Leipziger & Dodev, 2016 June). Colleges often struggle to cover the knowledge associated with these changes (Liu & Murphy, 2012). In addition, many of the future jobs may not exist today, so we as educators are challenged to link the educational pipeline to unknown jobs and to prepare students to be career-ready and competitive in a global economy (College for Every Student (CFES), 2016).

Our program addresses the challenge of bridging the gap between employers' expectations and our IT graduates' employability. The purpose of this paper is to present our workforce development framework and illustrate programming that can be used to guide other IT 4-year programs to tackle workforce readiness. Community colleges focus traditionally on workforce, but there is a perception that a 4-year school is more about knowledge-acquisition than career preparation. We elaborate the approaches taken in our curriculum to guide students through their college lives and to equip them with both hands-on, practical skills and knowledge as well as the capability and mindset to be life-long learners. We start these efforts

in the freshman year by preparing students to identify work experiences early in their college experience and to develop specific IT work-related skills that complement their ongoing knowledge acquisition.

A CLOSER LOOK AT WORKPLACE READINESS SKILLS

We examined several widely cited workforce readiness models (ACT, 2016; Carnevale & Smith, 2013; Casner-Lotto & Barrington, 2006; U. S. Department of Labor, 1991) and found that problem solving, critical thinking, teamwork, writing, and adaptability kept surfacing as common themes. Across disciplines, highly sought skills were not limited to specific domain knowledge or expertise. (Besson, 2014, August 25; Carnevale & Smith, 2013; Selingo, 2015, March 31). Instead, they are "*beyond specific discipline based skills and knowledge to more general skill sets including learning, reasoning, communicating, and problem-solving with knowledge that cuts across domains*" (Lawrence-Fowler, Grabowski, & Reilly, 2015, p. 1).

In the IT field, the Assessment & Teaching of 21st Century Skills (ATC21S) project, sponsored by Cisco, Intel, and Microsoft, defined four broad categories of 21st century skills as shown in Figure 1 (Binkley et al., 2012):

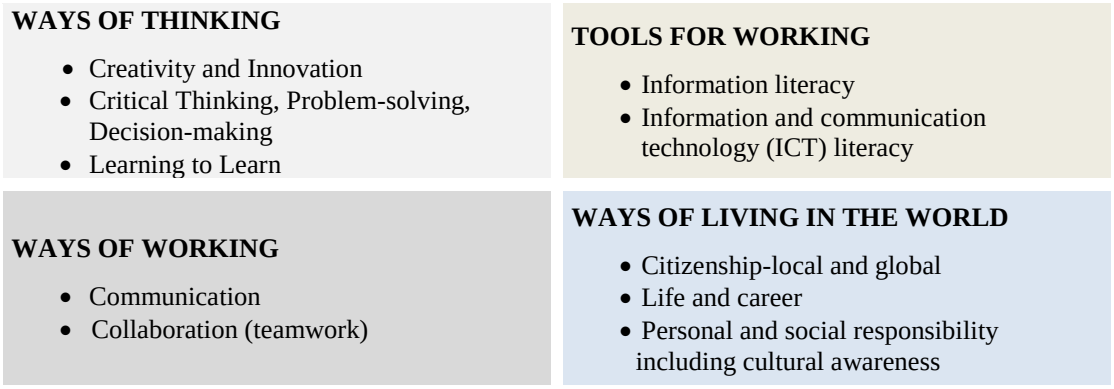

Figure 1. 21st Century skills (ATC21S, 2012)

As Kelli Wells, Executive Director of Education and Skills for the GE Foundation, pointed out the companies are looking for technology employees whose expertise runs deeper than the utilization of the technology itself (College for Every Student (CFES), 2016). What the employers really after are the intellectual curiosity, critical thinking, and problem-solving skills required to explore and deploy these computer systems and technologies.

GUIDING PRINCIPLES

We adopted the CERT® workforce development framework and integrated it with two core teaching and learning theories – the constructivist theory and the experiential learning model- as the major guiding principles in developing our IT program.

The CERT® Workforce Development Approach

The CERT® approach to workforce development (Hammerstein & May, 2010) builds knowledge, skills, and experience in a continuous cycle of four building blocks, as shown in Figure 2.

Figure 2. Workforce Development Framework (Adopted from Hammerstein & May, 2010)

We have integrated these components (knowledge building, skill building, experience, and evaluation) throughout the 4-year program as well as reinforced their individual contributions to workforce readiness. Students build up their knowledge in a variety of information technology, mathematics, and liberal arts courses. Through these courses and a series of seminars, the students develop important skills such as oral and written communications and teamwork. A variety of working experiences inside and outside the university help build up their information technology experience. Evaluation is a separate step providing continuous feedback.

Experiential Learning

Experiential learning focuses on "hands-on" experiences and "live" meanings of abstract theories and concepts through practical projects and internships. This guiding principle is corroborated by various surveys on which companies value most in their employees. One Association of American Colleges and Universities survey reported that 88% of employers wanted colleges to ensure that students completed an applied learning project before graduating (Hart Research Associates, 2015). The majority of employers surveyed stated that they were more likely to consider a job candidate who had participated in an internship, senior project, collaborative research project, or a field or community based project.

CURRICULUM PROGRAMMING TO IMPROVE WORKFORCE READINESS

This section covers what we have implemented to improve workforce readiness throughout the 4-year program using the frameworks described above.

Freshman

New students begin their exploration of the IT field by taking a foundation course on cybersecurity followed by a programming course, both courses involving active learning strategies. For example, students trace network routes and crack passwords. Students also begin to develop their writing and research skills by completing liberal arts core requirements in English composition. Another major component of the first year experience is the Discover course which introduces students to critical thinking, inquiry learning, and research. Both the English composition and Discover courses (i.e., service courses provided outside the IT department) are part of the university-level required courses. Freshmen also take an introductory business course, alongside business students who might become their teammates in the workplace. Finally, we introduce freshman to the resources of the Washington D.C. area by inviting IT professionals to class and taking students on site visits such as a recent visit to a Department of Homeland Security cybersecurity operations center.

Sophomore

Students continue developing their knowledge base with computer technology software engineering, and more advanced programming classes. They also take a one-credit IT seminar which focuses on starting their career preparation. In the seminar, we focus first on ensuring that the students have a full understanding of the entire range of jobs in the discipline, leading them to select a specialization for their junior and senior years. Next, we look at what they need in the way of personal "branding". They work on resumes and LinkedIn profiles. We bring in practitioners, from mobile developers to cybersecurity analysts, who work in business and government. These practitioners are usually two to ten years out in their careers and can directly relate to the students. Many are alumni who provide feedback on their own career pathways. Other parts of the seminar focus on teamwork and oral communications. Finally, we encourage students to look for entry-level job experiences on campus or in local businesses, and take advantage of our Washington DC location to identify work experiences within the Federal government. As a Catholic institution, we also focus on volunteer work and community services, identifying projects such as teaching safe technology use to senior citizens and developing web sites for local charities. All of these begin to prepare students for the workplace and dealing with supervisors and clients.

University requirements include three writing intensive courses after the freshman year's composition classes. We have built these into the IT curriculum, one in each of the three further years of the program (Liu & Murphy, 2012). In the sophomore year, students take Software Engineering, and must complete at least 4,000 words of writing through memos, formal documents such as a Software Requirements Specification, and ad-hoc writing. The student's work is subject to a formal review process, much as would happen in the workplace.

Junior

IT students begin to specialize in their field of interest: information systems, networking and cybersecurity, health information technology, computer science, data science, forensic computing, and interactive media. In addition, they complete a second writing intensive course, in software testing and quality assurance. In this course, students are exposed to technical writing in various forms including whitepapers (persuasive writing), detailed test cases, research reports, and they develop a user manual (including making a video). They also take a project management course, emphasizing teamwork and

problem solving, and a business ethics course to ensure they understand the rights and wrongs of working in the business world. These two courses are again taken with business students.

The one-credit IT junior seminar continues to explore the workplace with particular emphasis on finding a position (internship and/or job) in the IT field and in advancing their interviewing skills. We look at the hiring process in detail: the importance of networking, finding and analyzing job postings (including USAJobs, the Federal government resource), the role of the recruiter, the HR (Human Resource) perspective, telephone and face-to-face interviews, and the security clearance process.

Students are required to attend at least two external events in the semester. For the university events and the student clubs, students are encouraged to take leadership roles and work with faculty to develop IT specific programming. We also encourage them to join faculty members at meetups and other professional meetings.

By the junior year, about half of our students are working in the IT field in some capacity. Some take advantage of government programs like the government's Pathway Program https://www.usajobs.gov/Help/working-in-government/unique-hiring-paths/students/). Other students continue an internship as a part-time job until they graduate. Still others are working full-time. Because of their involvement in the workplace, we offer many of the junior and senior level courses in both day and evening options, alternating by semester.

Senior

The emphasis in the senior year is on completing the knowledge requirements as well as experiential learning, and applying the knowledge and soft skills gained. An internship is a requirement and the university's Career Center manages the day-to-day monitoring of the students in the workplace. Faculty members work with students to identify good internship opportunities and the junior seminar has prepared them for the identification and acquisition process. We also get many internship leads from alumni, from business contacts, and from the community. Placing international students can be more difficult because of limitations on earning income under an F-1 visa, so we work closely with the not-for-profit community to find unpaid internships where students can meet their service commitments.

A second part of our experiential learning program is the IT capstone project which is an opportunity for students to work independently on a project of their choice, under the supervision of a faculty member. It is the third writing-intensive course in the sequence. This project is meant to mirror the workplace where an employee is interested in a topic, must prepare a proposal and plan, conduct the work, and present the results to the other members of the organization. This course transitions the student from having deliverables defined for them in a syllabus, to having to plan and work independently.

The senior seminar focuses on the next steps in their career. A major component is the senior portfolio which is a summary of the student's expertise (knowledge and experience) presented in a formal document, as a Web site, and in a presentation to the group. Students must provide evidence of their accomplishments, such as code for a program they have written which then becomes artifacts that they can take to an interview in their field.

Students are also encouraged in both the junior and senior seminars to understand that the IT field is constantly changing and they must recognize their need to commit to life-long learning. New technology is constantly being developed and used in the workplace. As part of these seminars, students present their research on new technologies, as indicated on the Gartner Hype Cycle (http://www.gartner.com/technology/research/methodologies/hype-cycle.jsp). They are also expected to independently learn topics not covered in the main curriculum, such as cloud computing or the Python programming language, based on free resources on the Internet or from a book. Information literacy is taught throughout the curriculum and several courses involve research initiatives.

THE EVALUATION PROCESS

Students rate the classes each semester and feedback from these individual course evaluations is generally positive. Hands-on learning and other experiential learning activities.is always rated highly. Some of our workplace readiness activities also happen outside these formally evaluated courses.

In addition to the course-by-course evaluations, the university has a formal institutional assessment process which includes an annual outcomes assessment report and a five-year program review. The process is managed by an independent body — the Office of Planning and Institutional Effectiveness— that reports directly to the Provost. Graduating students and alumni receive exit surveys each year and evaluate themselves at the end of the program. There is no relationship between the researchers and the evaluation body.

The program has been in place since 2009 and so the results from the 2015-16 Graduating Student Survey, as shown in the table below, represent the opinions of students who have been in the program for four years as well as transfer students who

generally are in the program for two years. Nearly 50% of the students are transfer students from local community colleges who must meet all the liberal arts course and program requirements of the university.

27 respondents out of 35 graduating students took the survey (77% response rate). The survey uses a 5-point scale where 4/5 are considered good/very good and included in the percentages below.

Skill	Question	Response
Adaptability	Openness to new experiences	96%
	Apply knowledge and skills to a new situation	89%
Teamwork	Work as part of an effective team	85%
Writing	Develop a coherent written argument	70%
Verbal	Deliver a coherent oral presentation	70%
Problem solving	Solve problems using your knowledge and skills	89%
Ethics	Understand the major ethical dilemmas in your field	82%
Time management	Manage time effectively	82%
Lifelong learning	Interest in lifelong learning	93%
Global thinking	Awareness of global issues	89%
	Interest in cultures different from your own	96%
Leadership	Leadership skills	89%

Table 1. The 2015-16 Graduating Student Survey Results

In addition, 82% of students answered positively that they could find, or have found, a job in the field and 96% rated themselves as self-confident.

CONCLUSION

To meet the fast pace of change in the IT field, college students must graduate with portable competencies and skills. Career preparation is not just for the community colleges. Educators in 4-year schools must sustain a practical, career-oriented, and up-to-date curriculum to prepare our students for the increasingly competitive job market. The authors believe that it is the shared and coordinated responsibilities between college faculty, students, businesses, and the government to make this happen. This paper examines the gap between employers' expectations and current college graduates' career readiness from a faculty perspective. It uses our first-hand knowledge and experiences based on direct interactions with the students. The authors integrate the workforce development framework developed by CERT® with two core pedagogical theories as the overarching principles for a variety of curricular innovations and reforms as well as extra-curricular activities to improve students' competencies and employability. We believe that starting workforce readiness activities early in the program is one of the success factors of the program.

The self-evaluation results were generally positive with the need to continue to improve oral and written communication skills as an ongoing issue. We are planning to do more longitudinal evaluations of student success factors particularly once they are in the workplace as part of our continuous improvement of the program.

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